

# **Field Report for Airborne Data Collected In Support of US EPA Region 6 Intercontinental Terminals Company LLC Fire 21 March 2019**

## **Background**

On 17 March 2019 a large fire was reported at the Intercontinental Terminals Company LLC (ITC) located in Deer Park, TX. Local reports indicate that the fire started at about 1030 local in an 80,000 barrel (capacity) tank storing naphtha. The ITC facility is located on the southern shore of the Houston ship channel in the City of Deer Park, TX. The geographical coordinates of the facility are 19.7322N, 95.1236W (figure 1).

The material reported in the fire is Naphtha. Naphtha is generally composed of either the first or second sequence of distillate obtained during primary distillation. Light naphtha is composed of light fraction straight chain and simple aromatics, typically less than 6 carbons while heavy naphtha consist of larger compounds (C6 plus) which normally is used as feed for catalytic cracking. Since the fraction of Naphtha is crude dependent, there is not a simple formula for the material.

The US EPA Region VI requested that the ASPECT system be deployed to provide monitoring support on 17 March 2019 and ASPECT completed a 7 pass mission at 1847 local. Acetone was detected on the first 2 passes (data collection 3 and 4) which were near the fire at a concentration estimated below 1 ppm (0.154 ppm and 0.357 ppm, respectively). No other compounds were detected.

ASPECT conducted a second flight over the facility on 18 March 2019. Analysis of IR data confirmed reports that the fire had expanded to multiple tanks. Specifically, the thermal signature of the fire and resulting heated air plume was measurably larger than that observed in the first flight. Crew reports indicated that the plume rise was still active with the lofted plume occupying a region between 2000 and 6500 feet above ground with movement to the west. Spectral analysis of FTIR data indicated that compounds including 1-butene, 2-butene, isoprene, and acetone were detected primarily in a downwind portion of the plume with the highest values being just above 1 ppm.

ASPECT conducted a third flight over the ITC fire on 19 March 2019. Analysis of data indicated that the fire had grown as evident by the larger thermal signature and direct confirmation from aerial images. Plume geometry was assessed with the aircraft with findings showing the plume was about 47 miles in length, 17 miles wide at the largest extent and ranged in altitude from a floor of 1500 feet to a ceiling of 5000 feet. No chemical detections were reported on this flight.

ASPECT conducted a fourth flight over the ITC fire on 20 March 2019. Analysis of data indicated that the fire had been extinguished. Analysis of FTIR data showed detections of acetone and SO<sub>2</sub> to west of the farm and isobutylene and isoprene south of the farm. All concentrations were detected below 1 ppm.

Due to reports of vapors observed in the Deer Park vicinity ASPECT was requested to fly a mission on 21 March 2019 which is detailed in the following report. In general, the design of this flight called for data collection near the impacted tank farm, and locations in Deer Park, La Porte, Galena Park and Jacinto City.

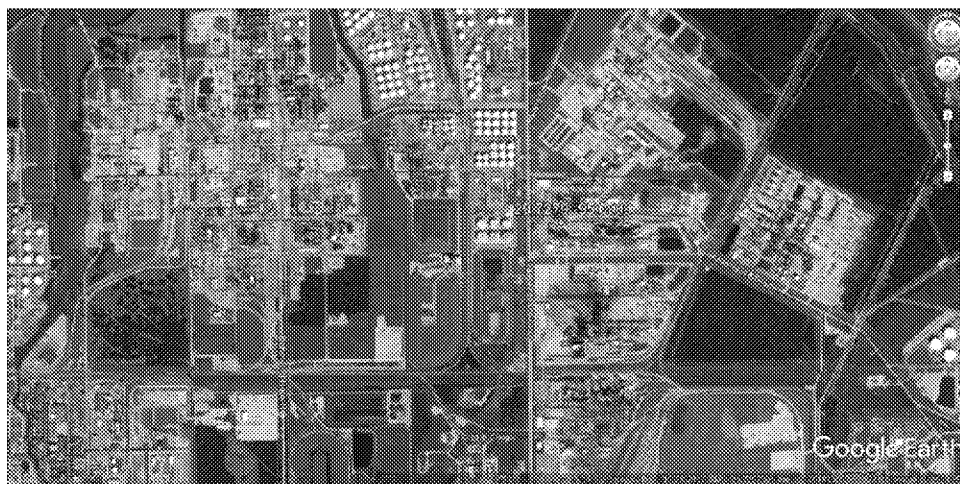


Figure 1: ITC, Deer Park, TX

**ASPECT response to this Mission/Incident was in support of:**  
US EPA Region 6. OSC: Adam Adams

### **ASPECT System**

The US EPA ASPECT system collects airborne infrared (IR) images and chemical screening data from a safe distance over the site (about 3,000 ft AGL). The system consists of an airborne high speed Fourier transform infrared spectrometer (FTIR) coupled with a wide-area IR line scanner (IRLS). The ASPECT IR systems have the ability to detect compounds in both the 8 to 12 micron (800 to 1200 cm<sup>-1</sup>) and 3 to 5 micron (2000 to 3200 cm<sup>-1</sup>) regions. The 8 to 12 micron region is typically known as the atmospheric window region since the band is reasonably void of water and carbon dioxide influence. Spectrally, this region is used to detect carbon - non-carbon bonded compounds. The 3 to 5 micron region is also free of water and carbon dioxide but typically does not have sufficient energy for use. This band does show use in high-energy environments such as fires. The carbon - hydrogen stretch is very common in this region.

A digital Nikon DX2 camera (12.4 mega pixel CMOS 3:5 aspect ratio, 28 mm wide-angle lens) collects visible aerial imagery as part of the core data product package. The camera timing system is connected to the primary IR sensors and provides concurrent

image collection when other sensors are triggered. All imagery is geo-rectified using both aircraft attitude correction (pitch, yaw, and roll) and GPS positional information. Imagery can be processed while in flight or approximately 600 frames per hour can be processed once the data are downloaded from the aircraft.

An Imperx mapping camera (29 mega pixels; mapping focal plane array) provides a similar aspect ratio and aerial coverage. Like the Nikon DX2, it is connected to the primary IR sensors and provides concurrent image collection when other sensors are triggered. These images are often digitally processed in lower resolution so they can be transmitted via satellite communication. The high resolution images (>20 MB each) are pulled from the ASPECT after the sortie and are available at a later time.

All aerial photographic images collected by the ASPECT system are ortho-rectified and geospatially validated by the reachback team. In general, this consists of conducting geo-registration using a Digital Elevation Model (DEM) which promotes superior pixel computation and lessens topographic distortion. The image is then check by a team member (using a Google Earth base map) for proper location and rotation

Data is processed using automated algorithms onboard the aircraft with preliminary results being sent using a satellite system to the ASPECT reachback team for QA/QC analysis. Upon landing preliminary data results are examined and validated by the reachback team.

## **Data Results Flight 5, 21 March 2019**

### **Weather Conditions and Crew Report**

Weather for the mission is given in table 1. The crew reported that winds at altitude (2800 ft) were from the north (000 degrees) at about 15 kts (7 m/s). No visible emissions were observed being generated by the tank farm. .

**Table 1. ITC Fire Mission Weather 20 March 2019**

Parameter	Surface (0900)	Surface (1100)	Surface (1215)
Wind direction	090 degrees	000 degrees	090 degrees
Wind speed	1 m/s	2.5 m/s	1 m/s
Temperature	16°C	22 °C	22 °C
Humidity	63%	38%	25%
Dew Point	9°C	3 °C	1 °C
Pressure	1021 mb	1021 mb	1021 mb
Ceiling	Not Reported	Not Reported	Not Reported

The order to launch the aircraft was given at 0845 local on 21 March 2019 and the aircraft was airborne at 0900. The initial data collection run over the site was at 0921 (local) and the aircraft made a total of 20 data collection passes; flight information is summarized in Appendix A and Figure 2.

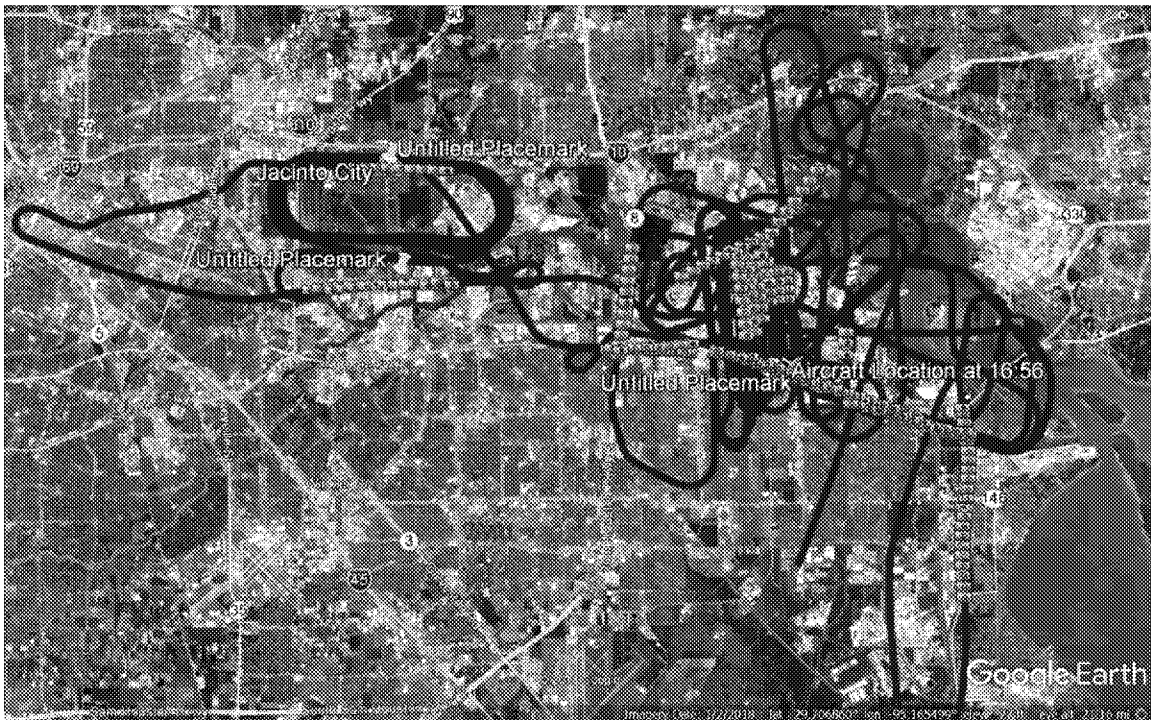


Figure 2: Flight line data for 21 March 2019. The blue lines represent the ASPECT flight path, green lines represent when the Infrared Line Scanner was actively collecting data, and the camera icons represent when a photo was taken.

### **General Data Quality Objective**

The following general data quality objectives are employed in conducting emergency response data collection with ASPECT:

1. To support overall situational analysis of the incident including aerial photography and IR imagery
2. To screen the incident for the presence of selected chemicals
3. To estimate the location and concentration of plumes being generated by the incident.

### **Line Scanner Data Results**

A total of 1 test and 20 data passes were made in the proximity of the impacted tank farm and also in extended areas surround the site and an infrared line scanner images were generated for each pass. Figure 3 shows a typical 3-band infrared image obtained from data collected for Run 5. Examination of the IR image shows a typical industrial scene. Thermal contours are included on the image and show that the tank farm is essentially at approximately 30 °C. It should be noted that process units in the general area are warmer than the tank farm. No plumes were detected in the image.



Figure 3: IR and Thermal analysis of ITC data for 21 March 2019, Run 2

In addition to a focus near the tank farm, ASPECT also conducted a general patrol in extended areas surround Deer Park. Figure 4 is a representative example of a long line scanner collection (Run 11) along highway 225. Analysis of the image showed no unusual signatures.

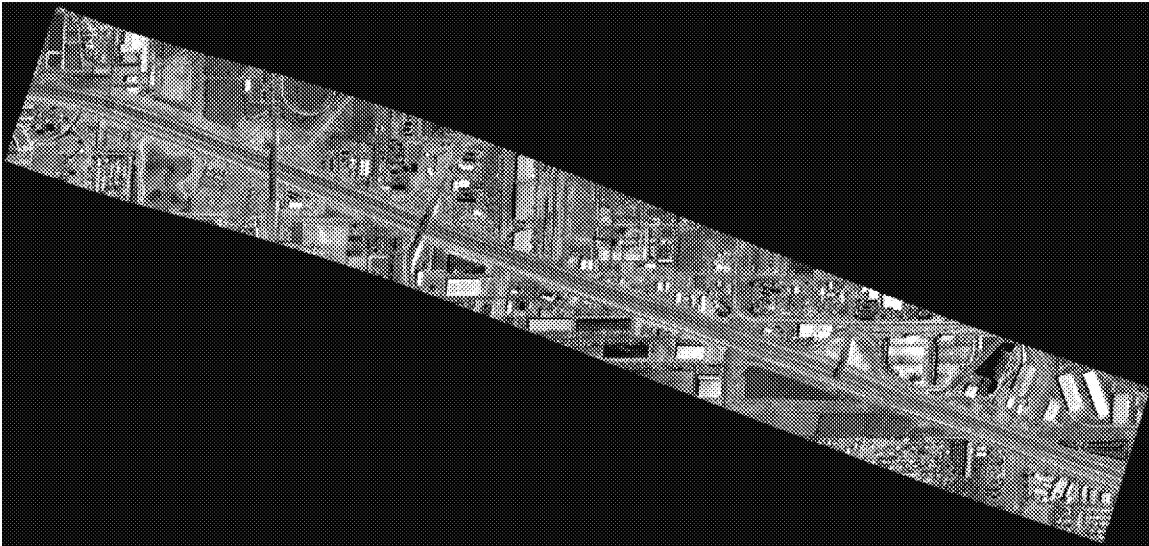


Figure 4: IR image along highway 225, 21 March 2019, Run 11

### **FTIR Data Results**

FTIR Spectral data at a resolution of 16 wavenumbers was collected for each pass. ASPECT uses an automated detection algorithm to permit compounds to be analyzed while the aircraft is in flight. 72 compounds are included in this algorithm and the list and associated detection limits are given in Table 2. In addition, collected data are also manually analyzed by comparing any detected spectral signatures to a collection of published library spectra.

An examination of FTIR data collected on this mission showed low level detections in the general vicinity around the tank farm (Figure 5). These detections included both acetone and isobutylene at levels less than about 1 ppm. Based on the wind direction these detections are likely associated with the normal atmosphere of the urban area.



Figure 5: ITC Fire, Chemical Detection Locations – 20 March 2019

A summary of chemical detections is given in table 3.

**Table 3. Chemical Results Summary**

Run	Date	Time (UTC)	Chemical	Max Concentration ppm
1	21 March 2019	0910	Test	Test
2		0921	ND	None
3		0925	ND	None
4		0929	ND	None
5		0933	ND	None
6		0936	ND	None
7		0940	ND	None
8		0945	Isobutylene	0.26
9		0950	ND	None
10		0959	ND	None
11		1007	ND	None
12		1017 1017A	Acetone	1.03
			Isobutylene	0.77
			Acetone	0.39
13		1028	Acetone	0.26
14	1038	ND	None	
15	1043	ND	None	



16		1052	ND	None
17		1058	ND	None
18		1105	ND	None
19		1138	ND	None
20		1143	ND	None
21		1154	ND	None
ND – Non-detect				

### Aerial Photography Results

A full set of high resolution aerial digital photography were collected as part of the flight. Figure 6 shows a representative overhead image collected as part of each pass. As evident in the image, the fires associated with the tank farm are absent. In addition, the secondary containment area of the tank farm appears to be filled with a white substance. Figure 7 illustrates a typical oblique image. Both images confirm the finding that the fire has been extinguished and that the secondary containment is filled with a white substance.



Figure 6: Aerial Image of the ITC Tank Farm, Flight 5





Figure 7: Oblique Image of the ITC Tank Farm, Flight 5

## Conclusions

ASPECT conducted a fifth flight over the ITC tank farm and surrounding area on 21 March 2019. Analysis of data showed normal temperatures within the farm and low levels of typical compounds within the urban atmosphere. Detected compounds included acetone and isobutylene at concentrations at or below 1 ppm.

## Appendix A

### Abbreviations:

DEM – Digital elevation model  
Alt – Altitude (in feet)  
MSL – Mean sea level altitude (in feet)  
Digital – Digital photography file from the Nikon D2X camera  
MSIC – Digital photography file from the Imperx mapping camera  
FTIR – Spectral IR data collected with a Fourier Transform  
Infrared Spectrometer  
IRLS – Infrared Line Scanner  
Jpg – JPEG image format  
UTC – Universal Time Coordinated  
img – Spectral data format based on Grams format

Mission: 2019-03-21 Houston Refinery Fire

Date: 3/21/2019

Time UTC: 14:03

Aircraft Number: N9738B

Pilot: James Glaviano

Copilot: Beorn Ledger

Operator: Steven Brister

Aft Operator: Jimmy Crisp

Ground Controller: Bob Kirby

DEM: Using elevation from DEM Database

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Run: 1 Time: 14:10:27 UTC

Alt: 2980 ft MSL Elev: 22 ft Elevation from DEM Database

Vel: 107 knots Heading: 179

Digitals: None

MSIC: 3

20190321141033311.jpg

20190321141039660.jpg

20190321141046930.jpg

FTIR: 1

20190321\_141031\_A.igm

IRLS: 1

2019\_03\_21\_14\_10\_32\_R\_01 TA=8.1;TB=27.9;Gain=3

Gamma Runs: None

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Run: 2 Time: 14:21:11 UTC  
Alt: 2780 ft MSL Elev: 18 ft Elevation from DEM Database  
Vel: 93 knots Heading: 355

Digital: None

MSIC: 4

20190321142117039.jpg  
20190321142124293.jpg  
20190321142130658.jpg  
20190321142137007.jpg

FTIR: 1

20190321\_142115\_A.igm

IRLS: 1

2019\_03\_21\_14\_21\_16\_R\_02 TA=6.7;TB=26.7;Gain=3

Gamma Runs: None

-----  
Run: 3 Time: 14:25:20 UTC  
Alt: 2728 ft MSL Elev: 27 ft Elevation from DEM Database  
Vel: 99 knots Heading: -3

Digital: None

MSIC: 4

20190321142526709.jpg  
20190321142533074.jpg  
20190321142539423.jpg  
20190321142545788.jpg

FTIR: 1

20190321\_142524\_A.igm

IRLS: 1

2019\_03\_21\_14\_25\_25\_R\_03 TA=9.1;TB=29.1;Gain=3

Gamma Runs: None

-----  
Run: 4 Time: 14:29:14 UTC  
Alt: 2841 ft MSL Elev: 27 ft Elevation from DEM Database  
Vel: 97 knots Heading: 358

Digital: None

MSIC: 4

20190321142920965.jpg  
20190321142927314.jpg  
20190321142933679.jpg  
20190321142940028.jpg

FTIR: 1

20190321\_142918\_A.igm

IRLS: 1

2019\_03\_21\_14\_29\_19\_R\_04 TA=9.5;TB=29.5;Gain=3

Gamma Runs: None

Run: 5 Time: 14:33:05 UTC  
Alt: 2900 ft MSL Elev: 15 ft Elevation from DEM Database  
Vel: 102 knots Heading: 353

Digitals: None

MSIC: 5

20190321143311602.jpg  
20190321143317936.jpg  
20190321143324285.jpg  
20190321143330634.jpg  
20190321143336999.jpg

FTIR: 1

20190321\_143308\_A.igm

IRLS: 1

2019\_03\_21\_14\_33\_10\_R\_05 TA=9.8;TB=29.8;Gain=3

Gamma Runs: None

-----

Run: 6 Time: 14:36:44 UTC  
Alt: 2874 ft MSL Elev: 16 ft Elevation from DEM Database  
Vel: 112 knots Heading: 351

Digitals: None

MSIC: 6

20190321143650383.jpg  
20190321143656748.jpg  
20190321143703097.jpg  
20190321143709447.jpg  
20190321143715812.jpg  
20190321143722161.jpg

FTIR: 1

20190321\_143647\_A.igm

IRLS: 1

2019\_03\_21\_14\_36\_49\_R\_06 TA=10.0;TB=30.0;Gain=3

Gamma Runs: None

-----

Run: 7 Time: 14:40:51 UTC  
Alt: 2898 ft MSL Elev: 13 ft Elevation from DEM Database  
Vel: 126 knots Heading: 352

Digitals: None

MSIC: 8

20190321144057336.jpg  
20190321144103701.jpg  
20190321144110051.jpg  
20190321144117320.jpg  
20190321144123670.jpg  
20190321144130019.jpg  
20190321144136384.jpg  
20190321144142733.jpg

FTIR: 2

20190321\_144055\_A.igm  
20190321\_144134\_A.igm  
IRLS: 1  
2019\_03\_21\_14\_40\_56\_R\_07 TA=10.5;TB=30.4;Gain=3  
Gamma Runs: None

-----  
Run: 8 Time: 14:45:15 UTC  
Alt: 2894 ft MSL Elev: 14 ft Elevation from DEM Database  
Vel: 123 knots Heading: 352

Digitals: None  
MSIC: 8

20190321144521544.jpg  
20190321144527909.jpg  
20190321144534258.jpg  
20190321144540608.jpg  
20190321144546973.jpg  
20190321144553322.jpg  
20190321144559687.jpg  
20190321144606036.jpg

FTIR: 2

20190321\_144519\_A.igm  
20190321\_144558\_A.igm

IRLS: 1

2019\_03\_21\_14\_45\_20\_R\_08 TA=9.9;TB=29.9;Gain=3  
Gamma Runs: None

-----  
Run: 9 Time: 14:50:24 UTC  
Alt: 2881 ft MSL Elev: 19 ft Elevation from DEM Database  
Vel: 112 knots Heading: 8

Digitals: None  
MSIC: 11

20190321145031149.jpg  
20190321145037498.jpg  
20190321145043863.jpg  
20190321145050212.jpg  
20190321145056577.jpg  
20190321145102927.jpg  
20190321145109276.jpg  
20190321145115641.jpg  
20190321145121990.jpg  
20190321145128355.jpg  
20190321145134704.jpg

FTIR: 2

20190321\_145029\_A.igm  
20190321\_145107\_A.igm

IRLS: 1

2019\_03\_21\_14\_50\_29\_R\_09 TA=10.2;TB=30.2;Gain=3  
Gamma Runs: None

-----  
Run: 10 Time: 14:59:43 UTC  
Alt: 2882 ft MSL Elev: 21 ft Elevation from DEM Database  
Vel: 113 knots Heading: 86

Digitals: None

MSIC: 14

20190321145949516.jpg  
20190321145956785.jpg  
20190321150003135.jpg  
20190321150009500.jpg  
20190321150015849.jpg  
20190321150022198.jpg  
20190321150028563.jpg  
20190321150034913.jpg  
20190321150041277.jpg  
20190321150047627.jpg  
20190321150053976.jpg  
20190321150100341.jpg  
20190321150106690.jpg  
20190321150113055.jpg

FTIR: 3

20190321\_145947\_A.igm  
20190321\_150026\_A.igm  
20190321\_150105\_A.igm

IRLS: 1

2019\_03\_21\_14\_59\_49\_R\_10 TA=11.4;TB=31.4;Gain=3

Gamma Runs: None

-----  
Run: 11 Time: 15:07:32 UTC  
Alt: 2929 ft MSL Elev: 22 ft Elevation from DEM Database  
Vel: 127 knots Heading: 102

Digitals: None

MSIC: 17

20190321150738009.jpg  
20190321150744359.jpg  
20190321150750724.jpg  
20190321150757978.jpg  
20190321150804343.jpg  
20190321150810692.jpg  
20190321150817058.jpg  
20190321150823407.jpg  
20190321150829756.jpg  
20190321150836121.jpg  
20190321150842471.jpg  
20190321150848820.jpg  
20190321150855185.jpg  
20190321150901534.jpg  
20190321150907899.jpg

20190321150914249.jpg  
20190321150921518.jpg  
FTIR: 3  
20190321\_150735\_A.igm  
20190321\_150814\_A.igm  
20190321\_150854\_A.igm  
IRLS: 1  
2019\_03\_21\_15\_07\_37\_R\_11 TA=13.6;TB=33.4;Gain=3  
Gamma Runs: None

-----  
Run: 12 Time: 15:17:32 UTC  
Alt: 2856 ft MSL Elev: 13 ft Elevation from DEM Database  
Vel: 100 knots Heading: -1

Digitals: None  
MSIC: 21

20190321151739058.jpg  
20190321151745407.jpg  
20190321151751757.jpg  
20190321151758121.jpg  
20190321151804471.jpg  
20190321151810836.jpg  
20190321151817185.jpg  
20190321151823534.jpg  
20190321151829899.jpg  
20190321151836248.jpg  
20190321151842613.jpg  
20190321151848962.jpg  
20190321151856217.jpg  
20190321151902581.jpg  
20190321151908931.jpg  
20190321151915296.jpg  
20190321151921645.jpg  
20190321151928010.jpg  
20190321151934359.jpg  
20190321151940708.jpg  
20190321151944343.jpg  
FTIR: 4  
20190321\_151736\_A.igm  
20190321\_151815\_A.igm  
20190321\_151854\_A.igm  
20190321\_151933\_A.igm  
IRLS: 1  
2019\_03\_21\_15\_17\_37\_R\_12 TA=14.1;TB=34.1;Gain=3  
Gamma Runs: None

-----  
Run: 13 Time: 15:28:55 UTC  
Alt: 2912 ft MSL Elev: 16 ft Elevation from DEM Database  
Vel: 118 knots Heading: 288



Digitals: None

MSIC: 12

20190321152900898.jpg  
20190321152908168.jpg  
20190321152914517.jpg  
20190321152920866.jpg  
20190321152927231.jpg  
20190321152933580.jpg  
20190321152939930.jpg  
20190321152946294.jpg  
20190321152952644.jpg  
20190321152959009.jpg  
20190321153005358.jpg  
20190321153009898.jpg

FTIR: 2

20190321\_152858\_A.igm  
20190321\_152937\_A.igm

IRLS: 1

2019\_03\_21\_15\_29\_00\_R\_13 TA=14.1;TB=34.1;Gain=3

Gamma Runs: None

-----  
Run: 14 Time: 15:38:04 UTC

Alt: 2883 ft MSL Elev: -2 ft Elevation from DEM Database

Vel: 114 knots Heading: 61

Digitals: None

MSIC: 10

20190321153809277.jpg  
20190321153816547.jpg  
20190321153822896.jpg  
20190321153829245.jpg  
20190321153835610.jpg  
20190321153841960.jpg  
20190321153848324.jpg  
20190321153854674.jpg  
20190321153901023.jpg  
20190321153907388.jpg

FTIR: 2

20190321\_153807\_A.igm  
20190321\_153846\_A.igm

IRLS: 1

2019\_03\_21\_15\_38\_09\_R\_14 TA=15.4;TB=35.4;Gain=3

Gamma Runs: None

-----  
Run: 15 Time: 15:43:09 UTC

Alt: 2831 ft MSL Elev: -1 ft Elevation from DEM Database

Vel: 132 knots Heading: 213

Digitals: None

MSIC: 9

20190321154316149.jpg  
20190321154322515.jpg  
20190321154328864.jpg  
20190321154335213.jpg  
20190321154341578.jpg  
20190321154347927.jpg  
20190321154354292.jpg  
20190321154400641.jpg  
20190321154406991.jpg  
FTIR: 2  
20190321\_154313\_A.igm  
20190321\_154352\_A.igm  
IRLS: 1  
2019\_03\_21\_15\_43\_15\_R\_15 TA=13.4;TB=33.0;Gain=3  
Gamma Runs: None

-----  
Run: 16 Time: 15:52:14 UTC  
Alt: 2836 ft MSL Elev: 14 ft Elevation from DEM Database  
Vel: 123 knots Heading: 272

Digital: None  
MSIC: 11  
20190321155219989.jpg  
20190321155226354.jpg  
20190321155232703.jpg  
20190321155239973.jpg  
20190321155246322.jpg  
20190321155252687.jpg  
20190321155259037.jpg  
20190321155305386.jpg  
20190321155311751.jpg  
20190321155318100.jpg  
20190321155324465.jpg  
FTIR: 2  
20190321\_155217\_A.igm  
20190321\_155257\_A.igm  
IRLS: 1  
2019\_03\_21\_15\_52\_20\_R\_16 TA=10.6;TB=30.6;Gain=3  
Gamma Runs: None

-----  
Run: 17 Time: 15:58:06 UTC  
Alt: 2787 ft MSL Elev: 18 ft Elevation from DEM Database  
Vel: 110 knots Heading: 271

Digital: None  
MSIC: 14  
20190321155811353.jpg  
20190321155818622.jpg  
20190321155824987.jpg  
20190321155831336.jpg

20190321155837686.jpg  
20190321155844052.jpg  
20190321155850401.jpg  
20190321155856750.jpg  
20190321155903115.jpg  
20190321155910369.jpg  
20190321155916734.jpg  
20190321155923083.jpg  
20190321155929433.jpg  
20190321155935797.jpg  
FTIR: 3  
20190321\_155810\_A.igm  
20190321\_155848\_A.igm  
20190321\_155927\_A.igm  
IRLS: 1  
2019\_03\_21\_15\_58\_12\_R\_17 TA=20.0;TB=37.7;Gain=3  
Gamma Runs: None

-----

Run: 18 Time: 16:05:46 UTC  
Alt: 2895 ft MSL Elev: 22 ft Elevation from DEM Database  
Vel: 116 knots Heading: 87

Digitals: None  
MSIC: 10  
20190321160552589.jpg  
20190321160558938.jpg  
20190321160605287.jpg  
20190321160611652.jpg  
20190321160618906.jpg  
20190321160625271.jpg  
20190321160631620.jpg  
20190321160637969.jpg  
20190321160644335.jpg  
20190321160645240.jpg  
FTIR: 2  
20190321\_160550\_A.igm  
20190321\_160629\_A.igm  
IRLS: 1  
2019\_03\_21\_16\_05\_52\_R\_18 TA=19.7;TB=39.7;Gain=3  
Gamma Runs: None

-----

Run: 19 Time: 16:38:48 UTC  
Alt: 2906 ft MSL Elev: 24 ft Elevation from DEM Database  
Vel: 116 knots Heading: 83

Digitals: None  
MSIC: 8  
20190321163854554.jpg  
20190321163900903.jpg  
20190321163907253.jpg

20190321163913617.jpg  
20190321163920871.jpg  
20190321163927236.jpg  
20190321163933585.jpg  
20190321163939950.jpg  
FTIR: 2  
20190321\_163852\_A.igm  
20190321\_163931\_A.igm  
IRLS: 1  
2019\_03\_21\_16\_38\_54\_R\_19 TA=19.6;TB=39.6;Gain=3  
Gamma Runs: None

-----  
Run: 20 Time: 16:43:29 UTC  
Alt: 3048 ft MSL Elev: 23 ft Elevation from DEM Database  
Vel: 113 knots Heading: 104

Digitals: None  
MSIC: 19

20190321164335091.jpg  
20190321164342360.jpg  
20190321164348710.jpg  
20190321164355074.jpg  
20190321164401425.jpg  
20190321164407774.jpg  
20190321164414139.jpg  
20190321164420488.jpg  
20190321164426837.jpg  
20190321164434107.jpg  
20190321164440472.jpg  
20190321164446821.jpg  
20190321164453170.jpg  
20190321164459535.jpg  
20190321164505884.jpg  
20190321164512233.jpg  
20190321164518598.jpg  
20190321164524948.jpg  
20190321164531312.jpg  
FTIR: 3  
20190321\_164333\_A.igm  
20190321\_164412\_A.igm  
20190321\_164452\_A.igm  
IRLS: 1  
2019\_03\_21\_16\_43\_35\_R\_20 TA=24.4;TB=44.7;Gain=3  
Gamma Runs: None

-----  
Run: 21 Time: 16:54:37 UTC  
Alt: 2947 ft MSL Elev: 16 ft Elevation from DEM Database  
Vel: 118 knots Heading: 291

Digitals: None

MSIC: 11

20190321165443319.jpg  
20190321165449669.jpg  
20190321165456033.jpg  
20190321165502383.jpg  
20190321165508732.jpg  
20190321165515097.jpg  
20190321165521446.jpg  
20190321165527811.jpg  
20190321165534160.jpg  
20190321165540509.jpg  
20190321165546874.jpg

FTIR: 2

20190321\_165440\_A.igm  
20190321\_165519\_A.igm

IRLS: 1

2019\_03\_21\_16\_54\_43\_R\_21 TA=24.7;TB=44.7;Gain=3

Gamma Runs: None